ALLEN-BRADLEY DF1 INTEGRATION KIT FOR ioCONTROL USER'S GUIDE

SNAP Simple I/O™
SNAP Ethernet I/O™
SNAP Ultimate I/O™

Form 1555-070416—April, 2007

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Table of Contents

Overview 1
- Introduction 1
- Requirements 1

ioControl Architecture 2
- ioControl Implementation 2
- Addressing Limitations 2

Installation 2
- Installing Integration Kit Files 2
- ioControl Configuration 3
- Configuring Serial Ports 3
  - With a Tag Database 3
  - Without a Tag Database 4
- Data Highway Communication Wiring 4
- Data Highway Communication 5
- Direct Serial Communication Wiring 5
- Direct Serial Communication 6

Subroutines 6
- AB Typed Read / AB Protected Typed Logical Read 6
  - Description 6
  - Parameters 6
- AB Typed Write / AB Protected Typed Logical Write 8
  - Description 8
  - Parameters 8
- AB_Slave 9
  - Description 9
  - Operation 9
  - Parameters 9

File Types 10

Error Reporting for ABMaster Subroutines 11
Error Codes Reported by the 1770-KF2 Module 11
Error Codes Reported by the PLC 11
PLC Extended Status Codes 12
Errors Reported by ioControl Master Subroutines 13
Errors Reported by ioControl Slave Subroutine 13

Allen-Bradley DF1 Integration Kit for ioControl

Overview

Introduction

The Allen-Bradley DF1 Integration Kit (Part # IOP-INT-ABDF1) provides users of Opto 22's ioControl software (version 6.0 and above) an easy method of communicating with Allen-Bradley drivers or PLCs using the DF1 protocol. Opto 22 controllers can act as either a *master* or a *slave* device. They can be connected directly to the serial port on an Allen-Bradley PLC or to Data Highway networks using standard Data Highway interface devices.

The kit includes a set of ioControl commands that can be used anywhere within an ioControl strategy. These commands provide ioControl applications the ability to exchange floating point, integer, I/O, ASCII, or string data with Allen-Bradley devices that support the DF1 protocol. The command set is made up of ioControl subroutines that transmit and receive serial messages according to the DF1 protocol specifications in the Allen-Bradley Data Highway/Data Highway Plus/DH-485 Communication Protocol and Command Set, publication number 1770-6.5.16.

Requirements

To implement an interface between an Opto 22 controller and an Allen-Bradley device, you will need:

- The Allen-Bradley DF1 Integration Kit
- An Opto 22 SNAP Ethernet-based controller (SNAP PAC R-series, SNAP-UP1-ADS, SNAP-LCE, SNAP-UP1-D64, SNAP-UP1-M64) with 6.0 or later firmware
- A PC running ioControl software (version 6.0 or later)
- A serial cable you provide to connect the Opto 22 controller to either the Data Highway interface device or the serial port of an Allen-Bradley PLC
- A PLC capable of supporting DF1 commands Typed Read/Typed Write or Protected Type Logical Read/Protected Type Logical Write, such as the SLC 500 and PLC5 Allen-Bradley PLCs.

ioControl Architecture

ioControl Implementation

The Allen-Bradley DF1 Integration Kit consists of a set of ioControl subroutines.

The master subroutines for the PLC5 family support the Typed Read (Read Block) and Typed Write (Write Block) commands. In addition, the PLC5 slave subroutine implements the Typed Read (Read Block) and the Type Write (Write Block) commands. For the SLC family of PLCs, the commands Protected Typed Logical Read and Protected Typed Logical Write have been implemented in both the master and slave subroutines. All these commands have been implemented to the element (word) level of addressing.

Addressing Limitations

The integration kit has the following PLC addressing limitations:

- The integration kit does not support reads or writes of individual bits.
- The integration kit does not allow reading and writing to PLC file numbers 2, 4, 5, or 6.
- The integration kit will not read or write to any PLC data files that have a file type other than integer, float, I/O, ASCII, string, or binary.
- The ioControl subroutines will access only the least significant 16 bits of any ioControl table or variable. The Allen-Bradley PLCs are 16-bit devices.
- Only one master can access the slave subroutines at a time.
- When the numbers are negative, the upper 16 bits will be set to 1 within the ioControl table to keep the numbers consistent with the PLC.

Installation

Installing Integration Kit Files

Insert the OptoIntegration CD to run the SETUP.EXE program.

The setup wizard will create the folder Program Files\Opto 22\Allen-Bradley DF1 Integration Kit for ioControl. This folder contains all the subroutine and support files for the integration kit, as well as example ioControl strategies.

NOTE: Integration kit documentation is in PDF format. If you don't already have Adobe Acrobat Reader installed, you will need it to view and print the supporting document. After installation is complete, you will have the option of installing Acrobat Reader.

ioControl Configuration

To use the integration kit with an ioControl strategy:

1. Start ioControl and open the strategy that you intend to use with the integration kit.
2. For each subroutine you intend to use with your ioControl strategy, choose Configure➞Subroutine Includes. Click the Add button and use the browser to select the subroutine file (.ISB extension).

   The subroutine appears in the Strategy Tree under the Subroutines Included folder.

   When you have added all the subroutines you need, they are ready for use in your strategy.

Configuring Serial Ports

With a Tag Database

If you are using a tag database, follow these steps to configure the serial ports:

1. If ioManager is not already open, choose Start➞Programs➞Opto 22➞ioProject➞ioManager.
2. Open the existing tag database or create a new one by choosing File➞New.
3. Double-click the I/O Units folder on the Strategy Tree.
4. In the Configure I/O Units dialog box, highlight the I/O unit's name in the list and skip to step 6, or click Add to add a new I/O unit.
5. Enter a name and description. In the Type drop-down list, choose your controller by its part number. In the Address field, enter the IP address of your controller. Click OK.
6. If you are connecting to the DH interface device using the serial port on the controller, follow these steps to configure the serial port:
   a. Still in the Configure I/O Units dialog box, click the Communications button and choose Communication Port Control from the pop-up menu.
   b. Click to put a check mark in the Used box.
   c. For the port number you are using, click the Value field for Control Function for Communication Port. From the drop-down list, choose None.
   d. Click OK.
7. If you are connecting to the DH interface device using a SNAP serial communication module on the I/O unit, follow these steps to configure the serial module:
   a. In the Configure I/O Units dialog box, click the Modules button and choose Serial Modules from the pop-up menu.
   b. For the module and port you are using, click the Status column and choose Enabled from the drop-down list. Change the serial settings as necessary. Click OK.
8. Choose Tools➞Send Configuration to I/O Unit. Make sure that the correct I/O unit is highlighted and that the Address List field shows the correct IP addresses to send the configuration to. Also make sure Save to Flash is checked. Click Send.

   IMPORTANT: Make sure you save your configuration to flash, or your settings will be lost when power is removed.

Without a Tag Database

If you are not using a tag database, you must still configure the serial ports using ioManager:

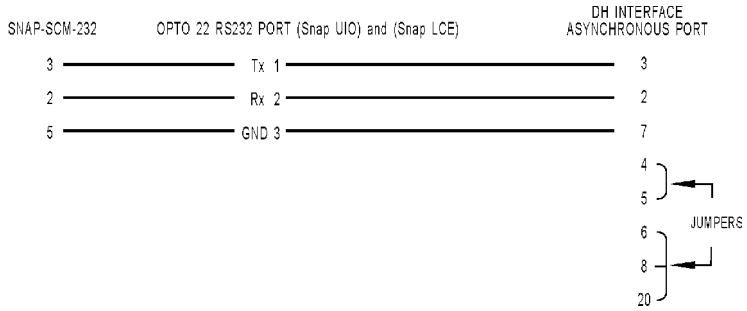
1. If ioManager is not already open, choose Start→Programs→Opto 22→ioProject→ioManager.
2. Click the Inspect button or choose Tools→Inspect.
3. In the IP Address field, type the IP address of the I/O unit or choose it from the drop-down list.
4. If you are connecting to the DH interface device using the serial port on the controller, click the Communications button and choose Communication Port Control from the pop-up menu. For the port you are using, click the Value column for Control Function For Communication Port and choose None from the drop-down list. Click Apply.
5. If you are connecting to the DH interface device using a SNAP serial communication module on the I/O unit, click the Communications button and choose Serial Modules. In the Serial Module Number field, choose the module's position on the rack. Change the serial settings as necessary. Click Apply.
6. Click the Status Write button. Under Operation Commands, select Store Configuration to Flash. Click Send Command.

   IMPORTANT: Make sure you save your configuration to flash, or your settings will be lost when power is removed.

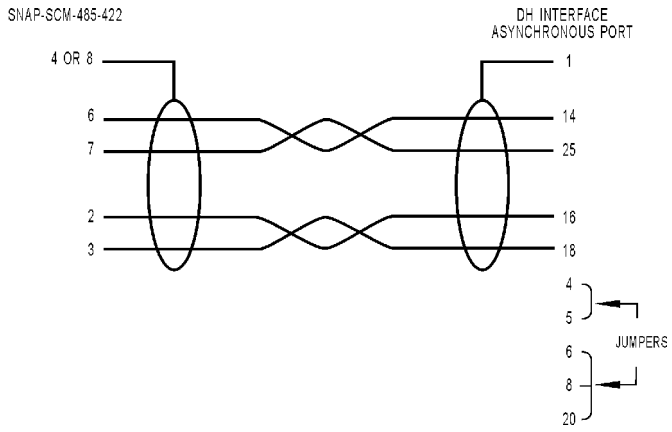
Data Highway Communication Wiring

The cables used for connecting an Opto 22 controller to a Data Highway interface device are specified in the drawings below. The cables require a DB25 female connector on the Data Highway interface end. Current Opto 22 controllers use screw-type terminal connectors.

Opto 22 RS-232 serial connection to DH interface device:



Opto 22 RS-422 serial connection to DH interface device:



Data Highway Communication

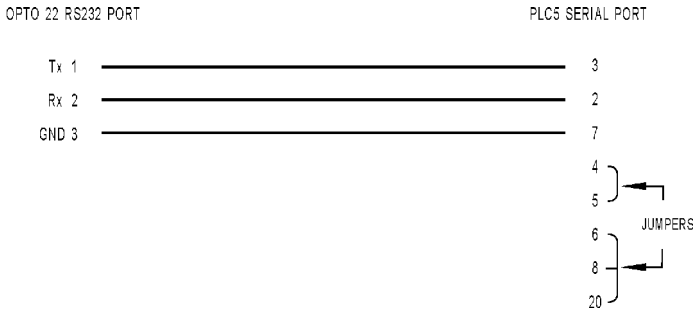
In order to communicate on the Data Highway network with an Opto 22 controller and a Data Highway interface device (for example, KF module or DL2000), the settings on the Data Highway interface device for baud rate, parity, and number of stop bits must match the serial handle passed to the subroutine, or the serial settings on the serial module. In addition, the following parameters should be set for the Data Highway interface device's asynchronous port:

- Use BCC error check mode.
- Do not use imbedded response mode.
- Disable handshaking.
- Use full duplex.

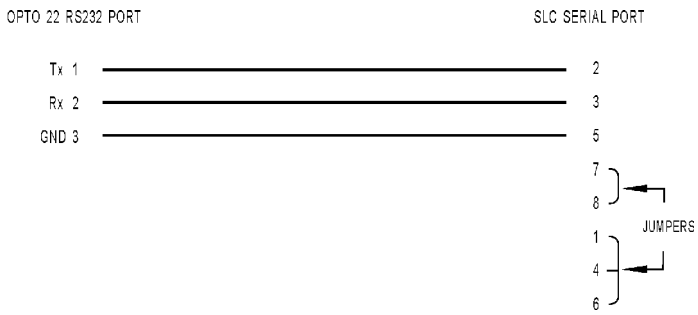
Direct Serial Communication Wiring

The cables used for connecting an Opto 22 controller to an Allen-Bradley PLC serial port are specified in the drawings below. The cable for a PLC5 requires a DB25 male connector on the PLC5 end. The cable for a SLC requires a DB9 female connector on the SLC end. Current Opto 22 controllers use screw-type terminal connectors.

Opto 22 RS-232 serial connection to PLC5/11 channel 0:



Opto 22 RS-232 serial connection to SLC5/04 RS232 port:



Direct Serial Communication

Full-duplex or half-duplex mode can be used to communicate directly between an Opto 22 controller and an Allen-Bradley slave device. Master subroutines only support half-duplex mode.

Subroutines

AB Typed Read / AB Protected Typed Logical Read

Description

AB Typed Read reads a block of data from a PLC 5 data file. AB Protected Typed Logical Read reads a block of data from an SLC 500 data file.

Parameters

Parameter Table (Integer 32 Values)

Enter the parameter table name in the field next to the prompt PARAMETER TABLE when calling the subroutine.

Element	Description
Element 0	Destination address of the slave device. PLC-5: 00-77 Octal.
Element 1	File Number within the slave device.
Element 2	Indicates the Starting Element Number within the file of the slave device. If accessing an Input or Output file, use this element to indicate the position of the I/O module. Example: If you have an input module in position 1, Element 2 should be set to 1 when trying to access the input or output file from that module.
Element 3	Starting Table Element Number in the associated ioControl table where source data to be written to the slave device is stored.
Element 4	Number of elements to copy.
Element 5	Amount of time in seconds that this subroutine will wait for a reply from a slave device.

Element	Description
Element 6	Communication Mode. 0 = Full-Duplex or Point-To-Point mode. -1 = Half-Duplex or Multidrop mode.
Element 7	Holds the Station Number of the Allen-Bradley 1770-KF2 Data Highway or Data Highway Plus Asynchronous (RS-232-C or RS-422-A) Interface Module. Half-duplex only.
Element 8	File Type. 1 = Integer, Output or Input, 2 = Floating Point, 3 = Binary, 4 = ASCII, 5 = String. If accessing Input (File No. 1) or Output (File No. 0) on the SLC processor, use this element for the Sub-Element Number (0 or 1) within the file of the slave device. Only used with File Numbers 0 and 1 on the SLC 5.

Integer 32 Table (Integer 32 Values)—This table is the data that will be read from the PLC.

Float Table (Floating Point Values)—This table is the data that will be read from the PLC.

String Table (String Values)—This table is the data that will be read from the PLC. For ASCII data only, the first two characters in each table element will be used.

Comm Handle (Communication Handle)

ser:<port number>,<baud rate>,<parity>,<data bits>,<stop bits>

- Port Number: 0 or 1
- Baud Rate: 115200, 76800, 57600, 38400, 19200, 9600, 4800, 2400, 1200, 300
- Parity: n, o, or e (none, odd, or even)
- Data Bits: 7 or 8
- Stop Bits: 1 or 2

tcp:<IP address>:<port number>

- IP Address: Address of the SNAP Brain the Serial Module is attached to.
- Port Number: Port number of the Serial Module.

  Slot 0: 22500 and 22501
  Slot 1: 22502 and 22503
  etc.
  Slot 15: 22530 and 22531

TNSValue (Integer 32 Values)—This variable keeps track of the TNS Value (Transaction Value) after the subroutine has closed. Add a numeric variable (Integer 32 Value) to your strategy. This is required by the DF1 protocol. Only one variable per strategy is required.

Error Code (Integer 32 Values)—Any error codes that the subroutine encounters will be passed back to the strategy through this variable.

AB Typed Write / AB Protected Typed Logical Write

Description

These subroutines write a block of data to a PLC data file. Cannot write to Input or Output files (file number 0 or 1).

AB Typed Write writes a block of data to a PLC 5 data file. AP Protected Typed Logical Write writes a block of data to a SLC 500 data file.

Parameters

Parameter Table (Integer 32 Values)

Element	Description
Element 0:	Destination address of the slave device. PLC-5: 00-77 Octal.
Element 1:	File Number within the slave device.
Element 2:	Indicates the Starting Element Number within the file of the slave device.
Element 3:	Starting Table Element Number in the associated ioControl table where source data to be written to the slave device is stored.
Element 4:	Number of elements to copy.
Element 5:	Amount of time in seconds that this subroutine will wait for a reply from a slave device.
Element 6:	Communication Mode. 0 = Full-Duplex or Point-To-Point mode. -1 = Half-Duplex or Multidrop mode.
Element 7:	Holds the Station Number of the Allen-Bradley 1770-KF2 Data Highway or Data Highway Plus Asynchronous (RS-232-C or RS-422-A) Interface Module. Half-duplex only.
Element 8:	File Type. 1 = Integer, 2 = Floating Point, 3 = Binary, 4 = ASCII, 5 = String.

Integer 32 Table (Integer 32 Values)—This table is the data that will be written to the PLC.

Float Table (Floating Point Values)—This table is the data that will be written to the PLC.

String Table (String Values)—This table is the data that will be written to the PLC. For ASCII data, only the first two characters in each table element will be used.

Comm Handle (Communication Handle)

ser:<port number>,<baud rate>,<parity>,<data bits>,<stop bits> • Port Number: 0 or 1 • Baud Rate: 115200, 76800, 57600, 38400, 19200, 9600, 4800, 2400, 1200, 300 • Parity: n, o, or e (none, odd, or even) • Data Bits: 7 or 8 • Stop Bits: 1 or 2
tcp:<IP address>:<port number> • IP Address: Address of the SNAP Brain the Serial Module is attached to. • Port Number: Port number of the Serial Module. Slot 0: 22500 and 22501 Slot 1: 22502 and 22503 etc. Slot 15: 22530 and 22531

TNSValue (Integer 32 Values)—This variable keeps track of the TNS Value (Transaction Value) after the subroutine has closed. Add a numeric variable (Integer 32 variable) to your strategy. This is required by the DF1 protocol. Only one variable per strategy is required.

Error Code (Integer 32 Values)—Any error codes that the subroutine encounters will be passed back to the strategy through this variable.

AB_Slave

Description

The AB_Slave subroutine is used to make an Opto 22 controller communicate like a PLC5 or SLC processor.

Operation

Create a new chart and ensure the appropriate slave subroutine call is the last command in the chart. Start and stop the subroutine by starting or stopping the associated chart.

Each subroutine monitors a serial port for AB message traffic and supports PLC files 0, 1, 3, 7, and 8 by using five ioControl numeric tables to hold the data. These five tables are passed by parameter to the subroutine. The AB_Slave subroutine requires a dedicated chart in ioControl.

Parameters

Slave Address (Integer 32 Values)—Indicates the address the slave subroutine will respond to. If using a DH+ interface device, this address must match the node ID number of the interface device.

File 0 - Output (Integer 32 Values)—File 0 of the subroutine.

File 1 - Input (Integer 32 Values)—File 1 of the subroutine.

File 3 - Binary (Integer 32 Values)—File 3 of the subroutine.

File 7 - Integer (Integer 32 Values)—File 7 of the subroutine.

File 8 - Float (Floating Point Values)—File 8 of the subroutine.

Comm Handle (Communication Handle))

ser:<port number>,<baud rate>,<parity>,<data bits>,<stop bits> • Port Number: 0 or 1 • Baud Rate: 115200, 76800, 57600, 38400, 19200, 9600, 4800, 2400, 1200, 300 • Parity: n, o, or e (none, odd, or even) • Data Bits: 7 or 8 • Stop Bits: 1 or 2
tcp:<IP address>:<port number> • IP Address: Address of the SNAP Brain the Serial Module is attached to. • Port Number: Port number of the Serial Module. Slot 0: 22500 and 22501 Slot 1: 22502 and 22503 etc. Slot 15: 22530 and 22531

Error Handle (Integer 32 Values)—Any error codes that the subroutine encounters will be passed back to the strategy through this variable.

File Types

The file type argument used with the master subroutines allows the read and write commands to handle each kind of data properly. It is set by storing the proper value in element 8 of the "PARAMETER TABLE" used with each call to a subroutine. The following table shows what file type value to use for each PLC file type.

File Types Used With AB Master Subroutines

ioControl File Type	AB File Type
1	Integer, Output, or Input.
2	Floating point
3	Unsigned integer
4	ASCII
5	String

Error Reporting for ABMaster Subroutines

Error Codes Reported by the 1770-KF2 Module

Code	Description
00	Success – no error.
02	Cannot guarantee delivery: link layer. The PLC may not be responding.
03	Duplicate token holder detected.
04	Local port disconnected.
05	Application layer timed out waiting for a response.
06	Duplicate node detected.
07	Station is offline.
08	Hardware fault.

Error Codes Reported by the PLC

Code	Description
16	Illegal command or format. SLC File Number vs. File Type mismatch.
32	Host has a problem and will not communicate.
48	Remote node host is missing.
64	Host could not complete function due to hardware fault.
80	Addressing problem or memory protect rungs.
96	Function disallowed due to command protection selection.
112	Processor is in program mode.
128	Compatibility mode file missing or communication zone problem.
144	Remote node cannot buffer command.
160	Not used.
176	Remote node problem due to download.
192	Cannot execute command due to active IPBs.
208	Not used.
224	Not used.
240	Indicates an extended error code. See “PLC Extended Status Codes” on page 12.

PLC Extended Status Codes

Code	Description
61441	A field has an illegal value.
61442	Less levels specified in address than minimum for any address.
61443	More levels in address than system supports.
61444	Symbol not found.
61445	Symbol is of improper format.
61446	Address doesn't point to something usable.
61447	File is wrong size.
61448	Cannot complete request, situation has changed since the start of the command.
61449	Data or file is too large.
61450	Transaction size plus word address is too large.
61451	Access denied, improper privilege.
61452	Condition cannot be generated; resource is not available.
61453	Condition already exists; resource is already available.
61454	Command cannot be executed.
61455	Histogram overflow.
61456	No access.
61457	Illegal data type.
61458	Invalid parameter or invalid data.
61459	Address reference exists to deleted area.
61460	Command execution failure for unknown reason.
61461	Data conversion error.
61462	Scanner not able to communicate with 1771 rack adapter.
61463	Adapter cannot communicate with module.
61464	1771 module response was not valid.
61465	Duplicated label.
61466	File is open; another node owns it.
61467	Another node is the program owner.

Errors Reported by ioControl Master Subroutines

Code	Description
-1	Received packet was too short.
-2	Received packet was too long.
-3	Unknown symbol received in packet.
-4	Reply timeout.
-5	BCC mismatch.
-6	Size error (data block won't fit into table or string).
-7	EOT limit exceeded (no response to half duplex poll).
-8	TNS mismatch (transmit and receive transaction numbers don't match.
-9	Too many NACK responses received.
-10	Could not acquire port.
-11	Bad control symbol received (half duplex).

Errors Reported by ioControl Slave Subroutine

These error codes will be returned by response string to the polling device as Extended Status Codes.

Code	Description
06h	Address doesn't point to something usable (bad address).
0Eh	Command cannot be executed (bad command or function code).
11h	Illegal data type (bad file number).